

Lake Okeechobee Protection Plan

**Revised Draft August 25, 2003
(Sections 1.0 through 3.3.4)**

Prepared by:



South Florida Water Management District



Florida Department of Environmental Protection



**Florida Department of Agriculture and
Consumer Services**

Assisted by:



**HDR Engineering, Inc.
West Palm Beach, Florida**

TABLE OF CONTENTS

DRAFT 8/25/03

1.0	Introduction	6
1.1	Legislation.....	6
1.2	TMDL – Lake and Tributaries	7
1.3	Phase II of Lake Okeechobee Construction Project	7
1.4	Revised Lake Okeechobee Operating Permit to meet TMDL by 2015..	8
2.0	Description of Lake Okeechobee and Watershed.....	8
2.1	Lake Okeechobee.....	8
2.2	Watershed Description.....	10
2.3	Watershed Flows and Phosphorus Loadings.....	13
3.0	Lake Okeechobee Protection Plan	17
3.1	Purpose	17
3.2	Requirements	17
3.3	Plan Formulation Process.....	17
3.3.1	Problem Identification	18
3.3.1.1	Watershed Baseline Data.....	18
3.3.1.2	Lake Okeechobee Watershed Current Activities.....	20
3.3.1.3	Planning Targets by Basin	22
3.3.2	Evaluation Criteria	20
3.3.3	Formulation of Alternatives	24
3.3.4	Evaluation of Alternatives.....	24
3.4	Preliminary Plan (each include description/schedule/cost)	TBD
3.4.1	Uncertainties and Assumptions	TBD
3.4.2	Plan Description.....	TBD
3.4.2.1	BMPs	TBD
3.4.2.2	Regional	TBD
3.4.2.3	Additional Regulatory Approaches.....	TBD
3.4.2.4	Additional Studies/Data Collection	TBD
3.4.2.5	Exotic Species Control	TBD
3.4.2.6	Internal Phosphorus Management	TBD
3.4.2.7	Upper Chain of Lakes/Istokpoga	TBD
3.4.3	Schedule.....	TBD
4.0	Implementation Strategies	TBD
4.1	Current Non regulatory / Incentives	TBD
4.1.1	Incentive Based BMPs.....	TBD
4.1.3	Public Private Partnerships.....	TBD
4.2	Regulatory	TBD
4.3	Market Based.....	TBD
4.3.1	Pollutant Trading.....	TBD
4.3.2	Phosphorus Import Surcharge and Phosphorus Credits.....	TBD
4.3.3	Private-Public Partnerships.....	TBD
4.4	Funding Options.....	TBD
4.4.1	South Florida Water Management Agency funding options.....	TBD
4.4.2	State Funding Options	TBD
4.4.3	Federal Funding Options	TBD
4.4.3.1	Farm Bill.....	TBD
4.4.3.2	Other Federal Agency Program	TBD

TABLE OF CONTENTS

DRAFT 8/25/03

5.0	Interagency Coordination and Outreach Program.....	TBD
6.0	Literature Cited	30

DRAFT

TABLES:

- 2-1: Total Phosphorus Loads (in metric tons) to Lake Okeechobee 1990-2002
- 2-2: Lake Okeechobee Protection Area Land Uses
- 2-3: Summary of Lake Okeechobee Inflow Phosphorus Loads

- 3-1: Summary of LOPP Problem Identification Results
- 3-2: Other P Reduction Projects

FIGURES

- 2-1: Lake Okeechobee Protection Plan Watershed Area
- 2-2: Criteria to Identify Potential Basin Treatment Alternatives

- 3-1: Other P Reduction Projects and Critical Projects
- 3-2: Process for Developing Alternative Plans

APPENDIX

- 3.A: Lake Okeechobee Protection Plan Watershed P Load Reduction Analysis
Summary Spreadsheet Description

DEFINITION OF ACRONYMS

DRAFT 8/25/03

Acronym	Definition
AgNMA	Agricultural Nutrient Management Assessment
AgNMP	Agricultural Nutrient Management Plans
ARC	Florida's Acquisition and Restoration Council
BAT	Best Available Technologies
BBL	Blasland, Bouck & Lee
BMP	Best Management Practices
C	Canal
CAFOs	Concentrated Animal Feeding Operations
CDS	Continuous Deflective Separation
CERP	Comprehensive Everglades Restoration Plan
CTSS	Chemical Treatment and Solids Separation
EAA	Everglades Agricultural Areas
EAAMOD	Everglades Agricultural Areas Model
ECP	Everglades Construction Project
EMS	Environmental Management Solutions
EPC	Equilibrium Phosphorus Concentration
F.A.C.	Florida Administrative Code
FDACS	Florida Department of Agriculture and Consumer Services
FDEP	Florida Department of Environmental Protection
FDER	Florida Department of Environmental Regulation
FFWCC	Florida Fish & Wildlife Conservation Commission
GIS	Geographic Information System
IFAS	Institute of Food and Agriculture Sciences
ILPM	Internal Loading Phosphorus Model
KOE	Kissimmee/Lake Okeechobee/Everglades
KRR	Kissimmee River Restoration
LLC	Limited Liability Corporation
LOEM	Lake Okeechobee Environment Model
LOIWRP	Lake Okeechobee Isolated Wetland Restoration Program
LOPP	Lake Okeechobee Protection Plan
LOWP	Lake Okeechobee Watershed Project
LOWQM	Lake Okeechobee Water Quality Model
LU	Land Use
NEP	National Estuary Program
NGVD	National Geodetic Vertical Datum
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
O&M	Operation and Maintenance
OOC	Out of Compliance
P	Phosphorus

DEFINITION OF ACRONYMS

DRAFT 8/25/03

Acronym	Definition
PPP	Public Private Partnership
PCA	Phosphorus Control Alternatives
PL	Public Law
PSCGP	Phosphorus Source Control Grant Program
QA/QC	Quality Assurance/Quality Control
RaSTA	Reservoir-assisted Stormwater Treatment Area
S	Structure
SAV	Sub-aquatic Vegetation
SFWMD	South Florida Water Management District
SRF	State Revolving Fund loan program
STA	Stormwater Treatment Area
SWIM	Surface Water Improvement and Management
TFS	Tampa Farm Service
TMDL	Total Maximum Daily Load
Toho	Lake Tohopekaliga
TP	Total Phosphorus
TST	Tributary Sediment Trap
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish & Wildlife Services
USGS	United States Geologic Survey
WAMView	Watershed Assessment Model (ArcView Platform)
WOD	Works of the District

1.0 Introduction

1.1 Legislation

The Lake Okeechobee Protection Program (Chapter 00-130, Laws of Florida) was passed by the 2000 Legislature. This Program committed the State of Florida to restore and protect Lake Okeechobee. This will be accomplished by achieving and maintaining compliance with water quality standards in Lake Okeechobee and its tributary waters, through a watershed-based, phased, comprehensive and innovative protection program designed to reduce phosphorus loads and implement long-term solutions, based upon the Lake's phosphorus Total Maximum Daily Load (TMDL). The Program sets forth a series of activities and deliverables for the coordinating agencies, which consist of the South Florida Water Management District (SFWMD); the Florida Department of Environmental Protection (FDEP); and the Florida Department of Agriculture and Consumer Services (FDACS). Elements specifically required by the legislation include the Lake Okeechobee Protection Plan and annual reports; the Lake Okeechobee Construction Project, a watershed phosphorus source control program; a research and water quality monitoring program, the in-lake phosphorus management program, an exotic species control program, and associated permits. The Lake Okeechobee Protection Plan, contained herein, identifies alternative plans, schedules and costs to meet the total phosphorus TMDL of 140 metric tons by the year 2015, as specified in the Protection Program.

An integrated watershed and Lake management strategy is being used to improve the condition of Lake Okeechobee. This strategy is based on the implementation of phosphorus source control programs, including Best Management Practices (BMPs) at the parcel level, implementation of sub-basin and regional phosphorus control technologies, and in-lake remediation projects. The information obtained from parcel-scale activities, existing regulatory programs, Phase I of the Lake Okeechobee Construction Project, and Lake inflow structure monitoring will be evaluated to assess the progress towards achieving the current and future phosphorus discharge standards into Lake Okeechobee.

Achieving the level of phosphorus load reduction required by the TMDL will require actions at all three scales previously described. At the parcel-scale individual landowners, both agricultural and nonagricultural, will implement measures to reduce the amount of phosphorus migrating off their land parcels into nearby waterbodies. Use of BMPs implemented as a non-regulatory process is considered the most appropriate parcel-scale action. The cooperating agencies are working together to identify and implement applicable BMPs for the major land uses in the watershed.

The Lake Okeechobee Protection Act defined Phase I of the Lake Okeechobee Construction Project as those project features designed to improve the hydrology and water quality of Lake Okeechobee and downstream receiving waters, consistent with the recommendations included in the South Florida Ecosystem Working Group's Lake Okeechobee Action Plan. Phase I of the Lake Okeechobee Construction Project includes projects identified as the Lake Okeechobee Water Retention Phosphorus Removal Critical Project that were authorized in the Water Resources Development Act of 1996. These include the isolated wetlands restoration projects and the construction of two stormwater treatment and detention facilities in the priority basins. Phase I also includes the Comprehensive Everglades Restoration Plan's (CERP) project for the Taylor Creek/Nubbin Slough Reservoir-assisted Stormwater Treatment Area (RASTA). A watershed assessment was initiated in January 2002 to define the extent and features of the CERP projects in the northern Lake Okeechobee watershed, including the Taylor Creek/Nubbin Slough RASTA.

1.2 TMDL – Lake and Tributaries

The Lake Okeechobee phosphorus TMDL of 140 metric tons was adopted by the State in May 2001. Attainment of the TMDL is calculated using a 5-year rolling average of the monthly loads computed from measured flow and concentration values at all inflows to the lake. The TMDL is allocated to atmospheric deposition (35 metric tons) and to the sum of nonpoint source inflows to the lake (105 metric tons). The implementation of the TMDL is in accordance to the Lake Okeechobee Protection Act (Section 373.4595, F.S.) and the Florida Watershed Restoration Act (Section 403.067, F.S.). These acts outline the implementation of management strategies following a phased watershed approach. The TMDL will be re-evaluated within 5 years of adoption (May 2006) as new information becomes available.

Additionally, FDEP will be developing TMDLs for impaired tributaries (as defined by the Impaired Surface Waters Rule (Rule 62-303, F.A.C.) within the Lake Okeechobee watershed. The schedule for development will follow the FDEP's Watershed Management Approach. Currently, TMDLs are being developed for tributaries within the S-191 basin. For additional information on TMDL development schedules please see <http://www.fdep.state.fl.us/water>.

1.3 Phase II of Lake Okeechobee Construction Project

Phase II of the Lake Okeechobee Construction Project calls for the development and implementation of those additional projects necessary to achieve the TMDL of 140 metric tons of phosphorus discharged to Lake Okeechobee by 2015. The specific plan that documents the construction facilities, size and location in the watershed, a construction and land acquisition schedule, and detailed schedule

of costs must be developed by January 2004. In addition, the plan must identify potential impacts on wetlands and state-listed species of concern that could occur as a result of the construction project and develop alternatives to mitigate and minimize these impacts, as appropriate. A number of current projects will be providing critical information necessary to develop the plan including the Comprehensive Everglades Restoration Program (CERP) Lake Okeechobee Watershed Project (LOWP), the implementation and effectiveness of BMPs and Best Available Technologies (BATs), and evaluations of alternative phosphorus reduction approaches.

1.4 Revised Lake Okeechobee Operating Permit (LOOP) to meet TMDL by 2015

On January 1, 2004, the SFWMD is required to submit to the FDEP a permit modification to the Lake Okeechobee Operating Permit (LOOP) to incorporate proposed changes necessary to ensure that discharges through the structures covered in the permit achieve state water quality standards, including the TMDL. These changes will be based upon the information provided in the Lake Okeechobee Protection Plan and Phase II of the Lake Okeechobee Construction Project and will be designed to achieve compliance with state water quality standards no later than January 1, 2015.

2.0 Description of Lake Okeechobee and Watershed

2.1 Lake Okeechobee

Lake Okeechobee is a large, shallow eutrophic lake located in south central Florida. The lake is the largest body of freshwater in the southeastern United States and covers a surface area of 730 mi² with an average depth of 8.6 ft. It is encircled by an embankment that is approximately 140 miles long with crest elevations ranging from 32 to 46 feet NGVD (URS 2002). Lake Okeechobee functions as the central part of a large interconnected aquatic ecosystem in south Florida and as the major surface water body of the Central and Southern Florida Flood Control Project. The Lake provides a number of values to society and nature including water supply for agriculture, urban areas and the environment, flood protection, a multi-million dollar sport and commercial fishery, and habitat for wading birds, migratory waterfowl, and the federally endangered Everglades Snail Kite. These values of the Lake have been threatened in recent decades by excessive phosphorus loading, harmful high and low water levels, and rapid expansion of exotic plants.

Specific Issues of Concern

Water Quantity

- During the last year, water levels in the lake have been above 15 ft for nearly 11 months, with only a short drop below that high level in early summer.
- A large number of pulse releases were made from the lake to the St. Lucie and Caloosahatchee Estuaries, in an attempt to minimize rising lake levels and reduce the risk of higher volume steady flow regulatory discharges to those downstream ecosystems.
- Despite these pulse releases, it became necessary to implement steady flow regulatory releases in late August due to continued rises in lake stage and increasing concerns regarding flood protection issues.
- The large releases of freshwater from the lake have had adverse impacts on water quality and biota in the estuaries.
- Although these adverse conditions occurred, the current lake regulation schedule (WSE = Water Supply and the Environment), adopted in summer 2000, kept the lake approximately 1 ft lower at its peak winter stage than would have occurred under the previous schedule.

Ecological Attributes

- The prolonged high water levels have resulted in substantial losses of both shoreline bulrush, grass beds, and submerged plants. The total acreage of submerged plants this year is just 60% of what was documented in 2002, and further losses are expected to occur.
- Algal blooms have been very common in the lake this year, and with the deep water, even occurred in areas that still had dense beds of plants. Once water depth reaches a certain level, plants are not able to effectively control water column nutrients, and noxious blooms can occur.
- Berms of organic material have begun to accumulate along the lake's north and northwest shoreline, similar to what happened in the lake in the late 1990s after a period of high water.
- Losses of plant communities are expected to have negative impacts on invertebrates, fish, wading birds, and other biota that use the lake for habitat.
- In summary, the overall health of the lake seriously declined from 2002 to 2003 due to sustained high levels of water.

Water Quality

- Total phosphorus concentrations in the Lake have more than doubled since the early 1970s, now averaging approximately 125 parts per billion (ppb).
- There is a high rate of phosphorus loading from both the watershed (external loads) and from the mud sediments within the Lake (internal loads).

In 2002, the annual load to Lake Okeechobee was 543 metric tons (Table 2-1). This is down slightly from 2001, despite increased flow, because the average concentration of phosphorus in the inflowing water declined from 207 ppb in 2001 to 155 ppb in 2002. The five year average phosphorus load from 1998 to 2002 was 554 metric tons, which exceeded the Lake Okeechobee TMDL by 414 tons. This five year average included the smallest measured historical load (169 metric

tons in 2000) due to the worst drought in recent history; and the largest measured load in the past decade (780 metric tons in 1998), which was a very wet year. These extremes demonstrate the reason that the TMDL is based on a five year average, to account for variations in water flow and loads.

Table 2-1. Total Phosphorus Loads (in metric tons) to Lake Okeechobee 1993-2002

Year	Measured Load ^a	Long-term Load (5-yr moving average) ^a	Long-term Over-target Load (5-yr moving average) ^{ab}
1993	296	375	235
1994	580	421	281
1995	683	478	338
1996	200	430	290
1997	470	446	306
1998	780	543	403
1999	670	561	421
2000	169	458	318
2001	607	539	399
2002 ^c	543**	554	414

^a includes an atmospheric load of 35 metric tons per year based on the Lake Okeechobee TMDL (FDEP 2000)

^b Target is the Lake Okeechobee TMDL of 140 metric tons (FDEP 2000) compared to a five year moving average

^c Year 2003 data will not be quality controlled/quality assured until June 2003

**For 2002, the average phosphorus concentration of waters entering the lake decreased from 207 ppb in 2001 to 155 ppb in 2002, while the flow increased.

2.2 Watershed Description

The Lake Okeechobee Watershed, as defined for this project, consists of the entire area that contributes surface water flow and phosphorus loads to Lake Okeechobee (see Figure 2-1). This includes lands that drain by gravity to the lake, as well as areas that are drained by pumping into the lake.

The project area consists of the northern Lake Okeechobee drainage area that generally includes the Taylor Creek/Nubbin Slough Basin, the Kissimmee River Basin, the Lake Istokpoga/Indian Prairie Canal/Harney Pond Basin, Fisheating Creek, and Nicodemus Slough. The project area also includes the St Lucie Canal drainage area (which contributes flow by gravity when Lake Okeechobee water levels are below 14.5 ft, NGVD) and the eastern segment of the Caloosahatchee River (which contributes flow by gravity when Lake Okeechobee water levels are below 11.5 ft, NGVD). Additionally, the project area includes

portion of the Everglades Agricultural Area from which runoff is pumped into Lake Okeechobee (Chapter 298 Districts).

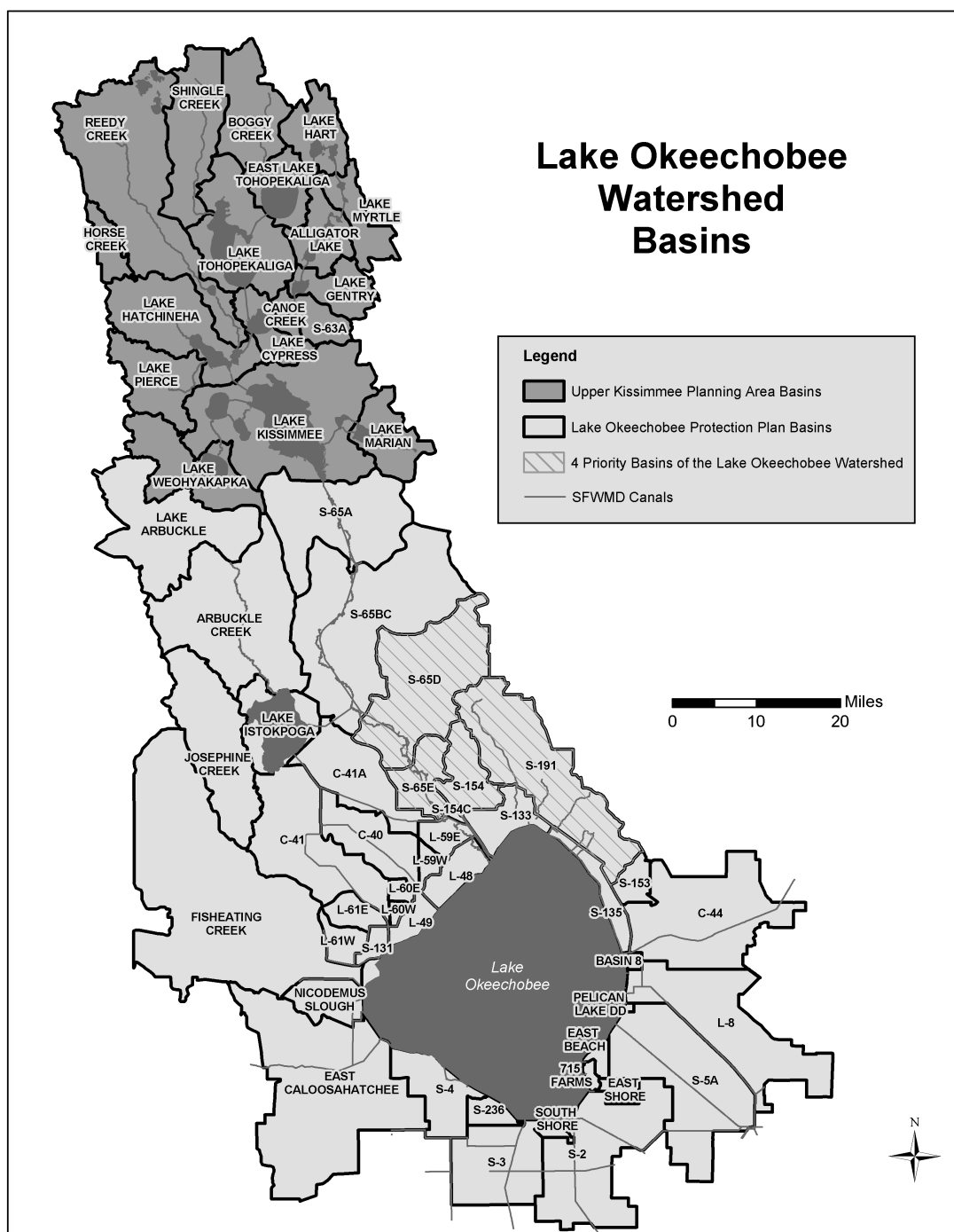


Figure 2-1: Lake Okeechobee Protection Plan Watershed Area.

Surface water runoff and phosphorus loads also reach Lake Okeechobee from the drainage areas upstream of Lakes Istokpoga and Kissimmee. Therefore, these areas are included as part of the watershed for development of the Lake Okeechobee Protection Plan. However, at this time, the drainage areas for these lakes will not be considered for implementation of additional phosphorus source control measures or regional water quality treatment facilities. More information is needed to develop the larger restoration measures needed for these areas. In addition, Lake Istokpoga and Lake Kissimmee create a buffering effect because the lakes are assimilating phosphorus that dampens or negates the impacts of upstream phosphorus reduction measures. In other words, the effects of phosphorus reduction measures implemented upstream of either lake may not be observed downstream of these lakes for many years. Since the LOPP is focused on achieving the Lake Okeechobee TMDL in the most cost effective manner that will achieve the goal by 2015, the drainage areas for Lakes Istokpoga and Kissimmee will not be addressed at this time. However, it is important to recognize that phosphorus reductions upstream of these lakes are beneficial to the health of these lakes and also is important to prevent future additional sources of phosphorus to the downstream receiving waters.

The total project area is approximately 3.5 million acres in size and is dominated by agricultural land uses as shown in Table 2-2. Agricultural land uses compose 1.8 million acres or about 52% of the total area. Natural areas compose about 1.2 million acres or about 36% of the total area. Urban areas compose about 400,000 acres or about 12% of the total area. The largest single land use is improved pasture (21% of the total area).

Table 2-2. Lake Okeechobee Protection Plan Area Land Uses

Land Use	Area (acres)
Citrus	210,082
Dairy	26,700
Improved Pastures	694,238
Natural	1,307,309
Other	101,183
Row Crops	23,770
Sod	33,180
Sugarcane	400,284
Tree Plantations	52,001
Unimproved/Woodlands/Rangeland	339,967
Urban	262,371
Total	3,451,086

2.3 Watershed Flows and Phosphorus Loadings

The phosphorus loads and flows into Lake Okeechobee have varied over time as a result of a combination of land use changes, variations in climatic conditions, and changes in land management practices. For purposes of this plan, the period of record from 1990 through 2000 was selected to represent the baseline against which alternative plans are compared.

This period of record was selected for the following reasons:

- LOPA was adopted during 2000
- It is consistent with the 2002 Update of the Lake Okeechobee Surface Water Improvement and Management Plan
- The data have been subjected to a thorough quality assurance/quality control process
- The period is generally representative of a combination of wet and dry conditions

The Lake Okeechobee watershed phosphorus loads for the 10-year baseline period of 1991-2000 were calculated for each of the 34 basins within the watershed by multiplying the annual discharge (in acre-feet) measured at each basin structure monitoring station by the observed flow-weighted P concentrations (in ppb) monitored at the designated monitoring station, for each basin. Table 2-3 is a summary of the drainage area of each basin identified in Figure 2.1 above, the average annual discharge, and the average annual phosphorus load in metric tons. The S65A – S65E basins were not separated from each other because the measurements at these structures do not capture the seepage and bypass flows, which are significant. In determining the basin loads from S65A through S65E, the discharge out of S65 (Lake Kissimmee) was subtracted from the S65E discharge. The result is assumed to be the contributions of flow and load from the S65A through S65E basins (SFWMD, 2002).

The Kissimmee River Basin (S-65 and S-65A, B, C, D, and E) contributes the largest volume of surface water flows into Lake Okeechobee. The total Kissimmee average annual flow is over 1.1 million acre-feet per year, or about 51% of the total surface water inflow.

Table 2-3. Summary of Lake Okeechobee Inflow Phosphorus Loads

Basin	AREA (acres)	Average Annual Discharge (1991-2000) (Acre-ft)	Average Annual P Load (1991-2000) (Mtons)
715 Farms (Culv 12A)	3,295	12,045	1.67
C-40 Basin (S-72)	43,964	16,266	9.58
C-41 Basin (S-71)	94,928	49,799	25.45
S-84 Basin (C41A)	58,488	51,791	9.06
S-308C (St. Lucie-C-44)	129,428	55,880	11.23
East Beach DD (Culv 10)	5,275	11,815	8.73
East Shore DD (Culv 12)	8,416	14,432	3.10
Fisheating Creek	289,366	200,766	40.97
Industrial Canal	8,232	23,337	2.99
L-48 Basin (S-127)	20,774	23,040	6.58
L-49 Basin (S-129)	12,093	13,189	1.69
L-59E	14,409	6,395	1.48
L-59W	6,440	8,319	1.93
L-60E	5,038	1,236	0.25
L-60W	3,271	419	0.07
L-61E	14,286	6,997	1.13
L-61W	13,567	10,646	1.27
Taylor Creek/Nubbin Slough (S-191)	120,754	101,946	78.40
S-131 Basin	7,164	9,490	1.28
S-133 Basin	25,660	26,478	6.99
S-135 Basin	18,089	25,408	3.39
S-154 Basin	33,798	24,630	23.59
S-2	106,044	31,399	8.16
S-3	64,630	9,794	2.33
S-4	39,673	29,164	6.87
S-65A,B,C,D,E	427,913	291,845	79.41
South FL Conservancy DD (S-236)	2,364	10,345	1.42
South Shore/So. Bay DD (Culv 4A)	2,947	8,151	1.07
Nicodemus Slough (Culv 5)	25,641	3,371	0.25
S65 (Lake Kissimmee)	1,021,674	856,146	69.95
Lake Istokpoga (S-68)	393,276	247,718	14.95
S5A Basin (S-352-WPB Canal)	120,798	11	0.00
East Caloosahatchee (S-77)	200,993	205	0.01
L-8 Basin (Culv 10A)	108,402	63,865	7.81
Total	3,451,087	2,246,336	433.09

The LOPA requires the coordinating agencies to develop criteria to site regional treatment alternatives in support of BMP efforts to reduce phosphorus loads within all of the basins in the Lake Okeechobee watershed. Treatment alternatives might include stormwater treatment areas, storage

retention/detention reservoirs, wetland restoration, chemical and/or other biological treatment, or combinations of each.

Each of the 34 basins within the Lake Okeechobee watershed contributes a specific volume of water containing a specific phosphorus concentration in the discharge. The combination of flow and concentration represents a given flow weighted concentration and phosphorus load to the lake. Historical water quality and quantity data is available from the SFWMD's basin monitoring program and water quality and quantity data generated from WAMView, a watershed assessment model used to evaluate relative quality and quantity contributions from each of the basins. In turn, this information was used to develop criteria to identify potential basin treatment alternatives (Figure 2-2).

Using the WAMView Model, each basin in the Lake Okeechobee watershed was divided into multiple sub-basins. The SFWMD's basin water quality and quantity data and the WAMView Model quality and quantity data was used to divide each of the sub-basins into the five distinct categories below.

1. Low volume high concentration
2. Low volume low concentration
3. Moderate volume moderate concentration
4. High volume low concentration
5. High volume high concentration

Each of these categories represents a given treatment alternative based on effectively and efficiently achieving the project objectives of water storage and water quality treatment. Those basins or sub-basins that typically discharge greater volumes of water with lower concentrations lend themselves to storage alternatives. Conversely, those basins or sub-basins that have lower discharges but higher concentrations lend themselves more to treatment alternatives. Combinations of storage and treatment may work in those cases that fall between the later two scenarios. Using this set of criteria, the coordinating agencies can begin to site regional projects that will accomplish the objectives of the LOPA.

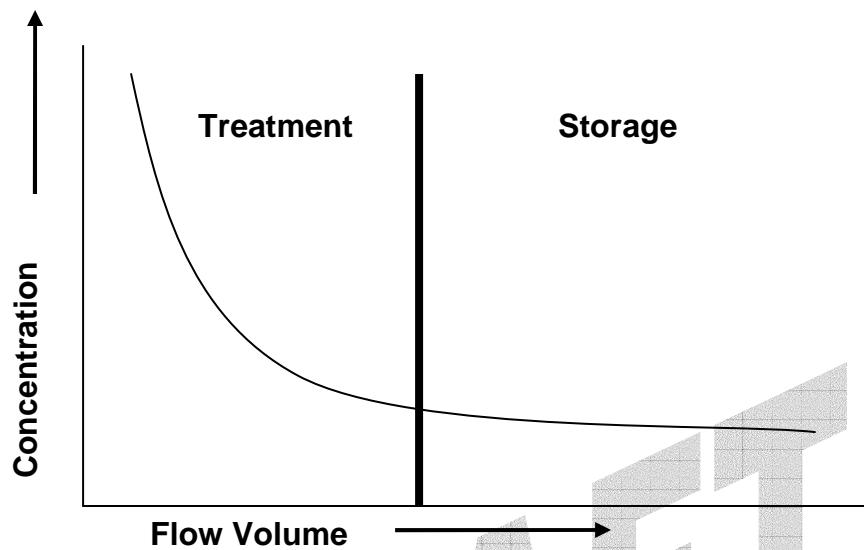


Figure 2-3: Criteria to identify potential basin treatment alternatives

3.0 Lake Okeechobee Protection Plan

3.1 Purpose

The Lake Okeechobee Protection Act (LOPA) contains three requirements that involve the development of a long-term comprehensive plan for all actions required to meet the Lake Okeechobee TMDL by 2015. The actions include:

- Development of the Lake Okeechobee Protection Plan (LOPP);
- Development of a implementation plan for Phase II of the Lake Okeechobee Construction Project; and
- An initial evaluation of further phosphorus measures that will be required to meet the TMDL, including:
 - Phase I Lake Okeechobee Construction Project
 - Watershed Phosphorus Control Program
 - Research and Water Quality Monitoring Program
 - Exotic Species Control Program; and
 - Internal Phosphorus Management Program

3.2 Requirements

The plan shall consider and build upon a review and analysis of the following relevant information resulting from:

- The performance of projects constructed during Phase I of the Lake Okeechobee Construction Project;
- The Lake Okeechobee Watershed Phosphorus Control Program;
- The Lake Okeechobee Research and Water Quality Monitoring Program;
- The Lake Okeechobee Exotic Species Control Program;
- The Lake Okeechobee Internal Phosphorus Management Program.

3.3 Plan Formulation Process

The LOPA requires that the LOPP be completed by January 1, 2004 by the SFWMD with the cooperation of the coordinating agencies. The coordinating agencies participated as full partners with the SFWMD in every step of the planning process. Public and stakeholder input were obtained at a series of public meetings conducted throughout the process (see Section 5).

A traditional planning process was utilized for the development of the LOPP. The planning steps are summarized below:

- Problem identification;
- Development of evaluation criteria;
- Formulation of alternatives;
- Evaluation of alternatives;
- Comparison of alternatives; and
- Description of the plan and implementation strategy.

3.3.1 Problem Identification

The problem is defined in the Lake Okeechobee phosphorus TMDL document (FDEP 2001) and the LOPA. The LOPA and “A Report to the Governor and the Legislature on the Allocation of Total Maximum Daily Loads in Florida (FDEP 2002)” provide initial guidance for achieving the required phosphorus reductions to achieve the TMDL. The allocation report states that when the primary contributors to an impaired water are nonpoint sources, the initial approach to achieve the TMDL is to implement BMPs over the areas represented by nonpoint sources and evaluate what phosphorus load reductions is obtained. Essentially, once 100 percent of the nonpoint sources have implemented BMPs, then the remaining load reduction is allocated to regional solutions. This is also consistent with the requirements of LOPA. The process for development of the LOPP accomplished this with the following steps:

1. Estimate load contribution from each basin/sub-basin (see 3.2.1.1 Watershed Baseline Data below);
2. Identify current land use and percent BMP implementation (see 3.3.1.2 Lake Okeechobee Watershed Current Activities - Owner BMPs below) ;
3. Estimate load reduction from 100% implementation of BMPs and other phosphorus reduction measures (see 3.2.1.2 Lake Okeechobee Watershed Current Activities - Ongoing Cost-share BMPs, Other Phosphorus Reduction Projects (including PPP), Regional Public Works Project); and
4. Determine remaining phosphorus load reductions required (see 3.2.1.3 Planning Targets by Basin).

3.3.1.1 Watershed Baseline Data

The first step in problem identification was to establish the watershed baseline data. Average annual flows and phosphorus loads (associated with surface water runoff) for each basin were computed based on measured data for the period from 1991 through 2000 (Table 3-1).

Table 3.1 Summary of LOPP problem identification results

Watershed Baseline Data				Lake Okeechobee Watershed Current Activities								Options for Achieving Remaining P Reductions									
Basin	AREA (acres)	Average Annual Discharg e (1991- 2000) (Acre-ft)	Averag e Annual P Load (1991- 2000) (Mtons)	Owner Implemented BMPs (1)		Funded Cost- Share BMPs (2)		Other P Reduction Projects (3)		Regional Public Works Projects (4)		Typ. Cost-Share BMPs that Require Future Funding (5)		Other Regional Projects (6)		Alternative Practices (7)		Target Based on Flow	Target Based on Load		
				Load Red. (Mtons)	Remain.L oad (Mtons)	Load Red. (Mtons)	Remain. Load (Mtons)	Load Red. (Mtons)	Remain . Load (Mtons)	Load Red. (Mtons)	Remain . Load (Mtons)	Load Red. (Mtons)	Remain. Load (Mtons)	Load Red. (Mtons)	Remain. Load (Mtons)	Load Red. (Mtons)	Remain . Load (Mtons)				
715 Farms (Culv 12A)	3,295	12,045	1.67	0.33	1.34	0.00	1.34	0.00	1.34	0.86	0.48	0.00	0.48	0.00	0.48	0.00	0.48	0.56	0.41		
C-40 Basin (S-72)	43,964	16,266	9.58	0.95	8.63	0.00	8.63	0.00	8.63	0.00	8.63	1.40	7.23	0.00	7.23	2.96	4.27	0.76	2.32		
C-41 Basin (S-71)	94,928	49,799	25.45	4.20	21.25	0.00	21.25	0.00	21.25	0.00	21.25	4.19	17.06	0.00	17.06	5.86	11.20	2.33	6.17		
S-84 Basin (C41A)	58,488	51,791	9.06	1.14	7.92	0.00	7.92	2.10	5.82	0.00	5.82	1.33	4.49	0.00	4.49	2.35	2.14	2.42	2.20		
S-308C (St. Lucie-C-44)	129,428	55,880	11.23	1.60	9.63	0.00	9.63	0.10	9.53	-1.72	11.25	1.56	9.69	0.00	9.69	2.60	7.10	2.61	2.72		
East Beach DD (Culv 10)	5,275	11,815	8.73	1.75	6.99	0.00	6.99	0.00	6.99	5.59	1.40	0.00	1.40	0.00	1.40	0.00	1.40	0.55	2.12		
East Shore DD (Culv 12)	8,416	14,432	3.10	0.62	2.48	0.00	2.48	0.00	2.48	1.59	0.89	0.00	0.89	0.00	0.89	0.00	0.89	0.67	0.75		
Fisheating Creek	289,366	200,766	40.97	2.28	38.69	0.00	38.69	0.00	38.69	0.00	38.69	3.29	35.40	0.00	35.40	12.46	22.95	9.38	9.93		
Industrial Canal	8,232	23,337	2.99	0.00	2.99	0.00	2.99	0.00	2.99	0.76	2.24	0.00	2.24	0.00	2.24	0.00	2.24	1.09	0.73		
L-48 Basin (S-127)	20,774	23,040	6.58	0.62	5.96	0.00	5.96	0.00	5.96	0.00	5.96	0.99	4.98	0.00	4.98	1.89	3.08	1.08	1.59		
L-49 Basin (S-129)	12,093	13,189	1.69	0.14	1.55	0.00	1.55	0.00	1.55	0.00	1.55	0.22	1.33	0.00	1.33	0.38	0.95	0.62	0.41		
L-59E	14,409	6,395	1.48	0.11	1.37	0.00	1.37	0.00	1.37	0.00	1.37	0.18	1.19	0.00	1.19	0.37	0.83	0.30	0.36		
L-59W	6,440	8,319	1.93	0.14	1.79	0.00	1.79	0.00	1.79	0.00	1.79	0.24	1.55	0.00	1.55	0.52	1.04	0.39	0.47		
L-60E	5,038	1,236	0.25	0.01	0.23	0.00	0.23	0.00	0.23	0.00	0.23	0.02	0.21	0.00	0.21	0.05	0.17	0.06	0.06		
L-60W	3,271	419	0.07	0.01	0.06	0.00	0.06	0.00	0.06	0.00	0.06	0.01	0.05	0.00	0.05	0.02	0.04	0.02	0.02		
L-61E	14,286	6,997	1.13	0.07	1.06	0.00	1.06	0.00	1.06	0.00	1.06	0.12	0.94	0.00	0.94	0.27	0.67	0.33	0.27		
L-61W	13,567	10,646	1.27	0.07	1.20	0.00	1.20	0.00	1.20	0.00	1.20	0.11	1.08	0.00	1.08	0.39	0.70	0.50	0.31		
Taylor Creek/Nubbin Slough (S-191)	120,754	101,946	78.40	6.23	72.17	4.56	67.61	36.97	30.64	7.25	23.39	10.53	12.86	46.90	-34.04	23.08	-57.13	4.77	19.01		
S-131 Basin	7,164	9,490	1.28	0.15	1.13	0.00	1.13	0.00	1.13	0.00	1.13	0.20	0.94	0.00	0.94	0.41	0.52	0.44	0.31		
S-133 Basin	25,660	26,478	6.99	0.49	6.50	0.00	6.50	0.37	6.13	0.04	6.09	1.78	4.31	0.00	4.31	1.70	2.61	1.24	1.69		
S-135 Basin	18,089	25,408	3.39	0.23	3.16	0.00	3.16	0.00	3.16	0.00	3.16	0.44	2.73	0.00	2.73	0.67	2.05	1.19	0.82		
S-154 Basin	33,798	24,630	23.59	1.34	22.25	1.70	20.56	12.77	7.79	0.00	7.79	3.57	4.22	0.00	4.22	7.05	-2.83	1.15	5.72		
S-2	106,044	31,399	8.16	0.00	8.16	0.00	8.16	0.00	8.16	7.98	0.18	0.00	0.18	0.00	0.18	0.07	0.12	1.47	1.98		
S-3	64,630	9,794	2.33	0.00	2.33	0.00	2.33	0.00	2.33	2.28	0.05	0.00	0.05	0.00	0.05	0.00	0.05	0.46	0.56		
S-4	39,673	29,164	6.87	0.00	6.87	0.00	6.87	0.00	6.87	6.87	0.00	0.00	0.00	0.00	0.00	0.12	-0.12	1.36	1.67		
S-65A,B,C,D,E	427,913	291,845	79.41	7.06	72.35	1.69	70.66	48.32	22.34	7.82	14.52	7.79	6.74	0.00	6.74	16.02	-9.29	13.64	19.25		
South FL Conservancy DD (S-236)	2,364	10,345	1.42	0.29	1.12	0.00	1.12	0.00	1.12	0.55	0.57	0.00	0.57	0.00	0.57	0.00	0.57	0.48	0.34		
South Shore/So. Bay DD (Culv 4A)	2,947	8,151	1.07	0.56	0.51	0.00	0.51	0.00	0.51	0.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.26		
Nicodemus Slough (Culv 5)	25,641	3,371	0.25	0.02	0.23	0.00	0.23	0.00	0.23	0.00	0.23	0.03	0.20	0.00	0.20	0.07	0.13	0.16	0.06		
S65 (Lake Kissimmee) **	1,021,674	856,146	69.95	4.58	69.95	0.00	69.95	0.00	69.95	0.00	69.95	8.42	69.95	0.00	69.95	10.47	69.95	40.02	16.96		
Lake Istokpoga (S-68)**	393,276	247,718	14.95	0.98	14.95	0.00	14.95	2.00	12.95	0.00	12.95	1.70	12.95	0.00	12.95	2.27	12.95	11.58	3.62		
S5A Basin (S-352-WPB Canal)	120,798	11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
East Caloosahatchee (S-77)	200,993	205	0.01	0.00	0.01	0.00	0.01	0.17	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00		
L-8 Basin (Culv 10A)	108,402	63,865	7.81	0.47	7.35	0.00	7.35	0.00	7.35	0.00	7.35	0.94	6.40	0.00	6.40	0.73	5.67	2.99	1.89		
Total	3,451,086	2,246,336	433.09	36.44	402.21	7.94	394.27	102.80	291.63	40.41	251.26	49.06	212.33	46.90	165.43	92.78	85.40	105.00	105.00		

* (1) through (7) Please see Appendix 3.A for descriptions.

**Reductions were applied to individual land uses within the Lake Kissimmee and Lake Istokpoga watershed basins. However, these reductions will have little or no short-term improvements on what is leaving the basins due to the lakes' internal buffering capacities. Therefore, these load reductions were not carried through the remaining spreadsheet and remaining loads are unchanged.

3.3.1.2 Lake Okeechobee Watershed Current Activities

A number of interagency and/or private phosphorus reduction projects have been implemented, are currently underway, or are planned in the Lake Okeechobee Watershed in response to the requirements of the LOPA, CERP, and ECP. These projects can be separated into four categories: owner implemented BMPs; ongoing cost-share BMPs; other phosphorus reduction projects; and regional public works projects. Funding has already been provided for these projects, so these projects will be considered to be in place as a starting point for development of the LOPP.

- Owner Implemented BMPs – These BMPs are described in the various BMP manuals adopted by FDACS (Rule 5M-3). Owner BMPs do not require cost-share. These BMPs were selected to represent the maximum contribution that could be implemented within the financial capabilities of the average landowner. Suites of owner implemented BMPs are land use specific. For example, Cow/Calf land uses may reduce P fertilizer, reduce stocking rates, or have better management of nitrogen and micronutrients.
- Funded Cost-Share BMPs - Phosphorus reductions associated with BMPs implemented under existing cost-share programs offered by FDACS and USDA-NRCS (i.e., BMPs associated with cow-calf and other agricultural commodities) as described in Botcher & Harper 2003 for different landuse categories. The current cost share being offered by FDACS is provided through State appropriations. Suites of funded cost-share BMPs are also land use specific. For example, Cow/Calf land uses may implement rotational grazing practices; install alternative water supply or stormwater retention/detention facilities; or enhance wetlands onsite.
- Other Phosphorus Reduction Projects - This category includes ongoing multi-year watershed projects to reduce phosphorus loading from the watershed. These projects and programs are described in Table 3.2 and depicted in Figure 3.1. These projects have been funded primarily through the following programs: Public-Private Partnerships, Phosphorus Source Control Grant Program, Dairy Best Available Technologies, and Isolated Wetlands Restoration. These projects have been partially or totally funded by State appropriations. An example of a public private-partnership is a partnership between SFWMD and Greencycle/QED. The Greenncycle/QED project will make a marketable organic fertilizer that can be exported from the watershed out of egg farm waste and treated waste from dairy operations.

Table 3.2 Other P Reduction Projects and Critical Projects

Other Phosphorus Reduction Projects	Project	Project Description
Phosphorus Source Control Grant Program	Tampa Farms Composting Facility	Composting chicken manure exported from watershed
	Milking "R" Chemical Treatment	Optimizing dairy stormwater treatment system
	Solid Waste Authority	Tri-county biosolids pelletization
	QED--McArthur Farms 3	Dairy farm wastewater treatment system
	Candler Ranch	Runoff treatment - iron humate filter
	Davie-Dairy Cooling Pond	Concrete cooling ponds
	Evans Properties--Bassett Grove	Citrus grove stormwater system retrofit
	Okeechobee Utility Authority – Ousley Estates	Gravity sewer system replacing septic and package plants
	Lofton Ranch	Wetland restoration
	Smith Okeechobee Farms	Stormwater retention and wetland restoration
Dairy Best Available Technology	Dry Lake 1	Edge of farm stormwater retention/detention with chemical treatment
	Butler Oaks	
	Davie Dairy 1 & 2	
	Fourth Site	
Silica Soil Amendment Evaluation Project	Larson Dairy 6	Soil amendment application to bind residual phosphorus
	Milking R	
Isolated Wetland Restoration Program	Kirton Ranch	Wetland restoration on agricultural properties (approximately 575 acres)
	Hazellief	
	McArthur Farms	
	Williams Ranch	
4th St. Boat Ramp Project	Residential and commercial area around 4 th Street in Okeechobee	Urban stormwater retrofit including baffle box and regarding swales
Former Dairy Remediation	Lamb Island Dairy Remediation	Remediation of properties that were previously dairy utilizing stormwater detention, wetland treatment, lagoon remediation, and soil amendments
	Lamb Island Dairy Tributary Stormwater Treatment Project	
	Five former dairy sites	
Regional Public-Private Partnership	AquaFlorida	Regional Stormwater Treatment Area in the C-41A Basin
	GreenCycle and QED	Dairy waste separation and treatment facilities and an organic fertilizer plant utilizing dairy and chicken manure
	Davie Dairy 1 & 2	Chemical treatment of 800 acres of off-site runoff

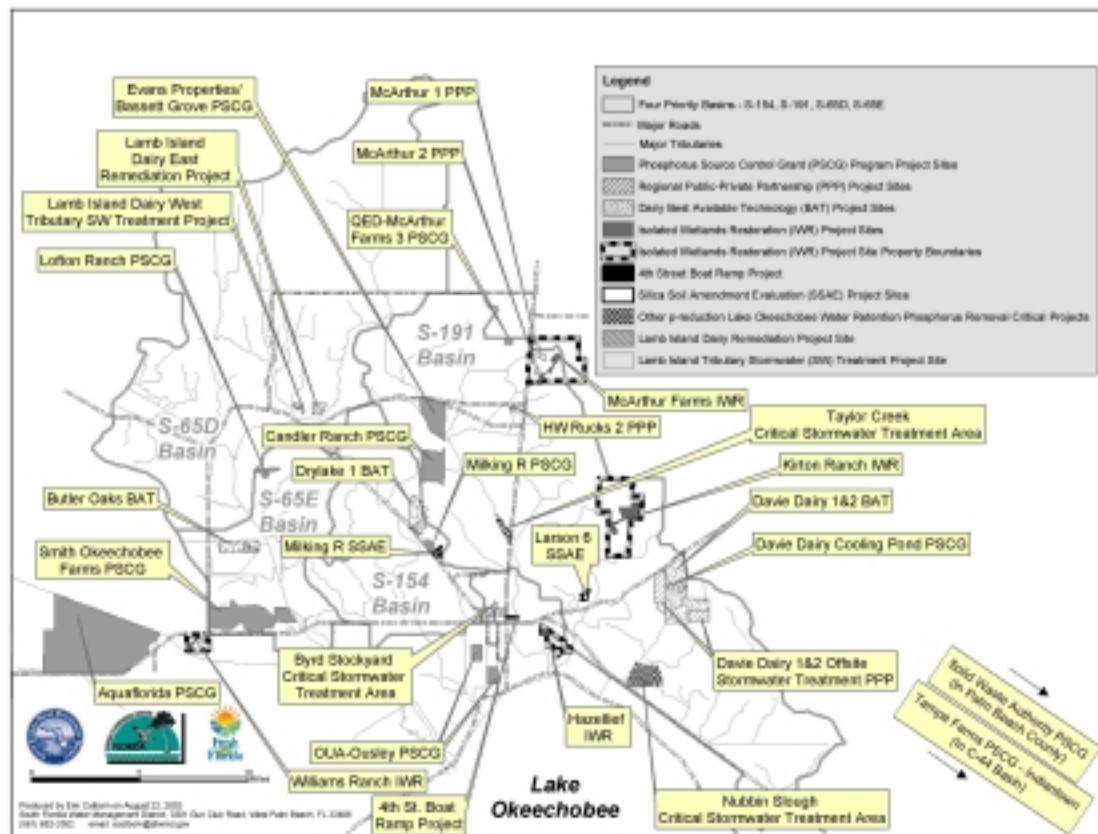


Figure 3.1 Other P Reduction Projects and Critical Projects

- Regional Public Works Projects** – Reductions in phosphorus loads to Lake Okeechobee will occur as a result of other regional public works projects. These projects include: EAA Storage Reservoir (CERP); Diversion of 298 Districts Flows (ECP), Lake Okeechobee Water Retention Phosphorus Removal Critical Project, and the Kissimmee River Restoration Project. Other projects included in this category that are expected to have an influence over phosphorus loads to the Lake are the C-44 Basin RASTA (CERP) and the C-43 Caloosahatchee Backpumping with Stormwater Treatment (CERP). These projects and programs are described in the Indian River Lagoon Feasibility Study (2002) and C&SF Comprehensive Review Study (1999).

3.3.1.3 Planning Targets by Basin

Another aspect included in the problem identification phase was the development of planning targets for phosphorus load reduction for each basin. These targets are for planning purposes only and are not an attempt to develop a more detailed allocation for the Lake Okeechobee phosphorus TMDL. However, in order to develop a plan that is equitable, cost-effective, and takes into account geographic and hydrologic conditions, planning targets were needed for each basin using two different approaches. Both approaches achieve the 105 metric ton inflow needed to achieve the TMDL. The target calculated for the first approach is based on basin flows relative to total Lake Okeechobee inflows. The target under the second approach is based on basin phosphorus loads relative to total Lake Okeechobee phosphorus loads.

Flow Based Basin Target = (Basin Flow / Total Lake Okeechobee inflow) X 105

Load Based Basin Target = (Basin Load / Total Lake Okeechobee Load) X 105

Table 3-1 provides a summary of the results of the problem identification process. Appendix 3.1 describes the results presented in Table 3.1 in more detail. The target information from these two approaches will be used in implementing the alternatives. For example, it would be used in determining the design and siting of regional projects identified in the selected alternative.

3.3.2 Evaluation Criteria

A set of evaluation criteria were developed for use by the coordinating agencies in the evaluation of potential alternatives (see below). The alternatives consist of a combination of components that include typical agricultural and urban BMPs, in addition to regional treatment facilities and/or non-traditional or “atypical” BMPs that would collectively meet the TMDL.

The evaluation criteria represent the major factors that were used to evaluate alternatives and identify the plan. They also support the overall goals and objectives of the project. Each evaluation criterion consists of the following components:

- **Description** – what the criteria is measuring and why.
- **Rationale** – description of why the criterion is useful for measuring project results, which will assist in determining the weighting or relative importance of each criterion.
- **Target** – description of how performance will be measured for the evaluation criteria and what will constitute success (or failure) and procedures for scoring various levels of performance.
- **Methodology** – description of how the performance of the alternatives will be evaluated. Most evaluations will be subjective using best professional judgment. The methodology provides descriptions of

specific considerations that will apply for subjective evaluations. For criteria where quantifiable measures are possible within the available timeframe, the methodology provides specific descriptions of the models, computations, analyses, etc that will be required to evaluate performance.

Evaluation Criteria	
Protect Native Flora and Fauna (in lake)	Potential to Reduce Exotic Species
	Potential to Protect or Enhance Native Flora and Fauna
	Potential to Impact State-Listed Species
Protect Native Flora and Fauna (Watershed)	Potential to Reduce Exotic Species
	Potential to Protect, Enhance or Create Native Flora and Fauna (1 Improve hydrology, 2 Protect)
	Potential to Impact State-Listed Species
Achieve State WQ Standards	Potential to Meet Other WQ Standards in Lake Okeechobee
	Potential to Improve Tributary WQ
Maintain State WQ Standards	Potential to Identify/Control Changes in WQ from Projects/Technologies
	Potential to sustain performance
Meet 2015 TMDL	Potential to Reduce External Phosphorus Loads to Lake Okeechobee
	Potential to Increase Exports & Decrease Imports of P from Watershed
	Potential to Reduce Phosphorus Loads to Tributaries
Minimize Negative Economic Impact on Land Owners	Potential for Cost Share and other incentives
Minimize Negative Economic Impact on Regional Economy	Regional Cost (tax base, jobs, etc)
	Potential for Recreational Opportunities
Cost	Potential to Maximize Federal Cost Sharing
	Potential to Increase Public/Private Partnerships
	\$/lb of P removed (inflow) (must be evenly applied)
Impact Existing Permitted Users	Potential to impact water supply
	Potential to impact flood protection
Early Results	Early Load Reduction
	Early Implementation
Feasibility	Sensitivity to Weather
	Acceptability (Socioeconomic)
	Track Record
	Operations & Maintenance
	Reliability of Technology

3.3.3 Formulation of Alternatives

The following potential phosphorus reduction components, management practices, and research monitoring needs were considered in the formulation of the alternative plans.

- Typical Cost-Share BMPs that require future funding - These BMPs will be identified for each agricultural landowner through an assessment described in the BMP manuals published by FDACS, nutrient management plans, or conservation plans through USDA-NRCS. Since implementation of these BMPs will be beyond the financial capabilities of the average landowner, additional funding will be required for implementation. The urban BMPs will be identified through stormwater and wastewater master plans.
- Other regional projects - These projects include the expansion of Nubbin Slough and Taylor Creek pilot STAs to include reservoirs and larger STA areas. Additional water from the S-191 basin, and neighboring basins, will be treated by the two STAs and will result in a potential phosphorus load reduction of 46.9 metric tons per year. The total reduction from all of the contributing basins have been accounted for in the S-191 basin for planning purposes (see table 3.1). Another project would include connections of septic tanks and small package wastewater treatment plants to a regional treatment facility.
- Alternative Practices - This would consist of more aggressive BMPs to be implemented by landowners with cost-share from FDACS. Alternative practices are more aggressive Typical Cost-Share BMPs and go beyond those that are contained in existing BMP manuals. Edge-of-farm chemical treatment is an example of an alternative practice. This category also includes establishing nutrient balances and/or alternative technologies.
- The Lake Okeechobee Watershed Project (LOWP) - The LOWP is being implemented as part of the Comprehensive Everglades Restoration Plan. It consists of four components: Taylor Creek/Nubbin Slough Storage and Treatment Area; the North of Lake Okeechobee Water Storage Reservoir; Lake Okeechobee Water Quality Treatment Facilities; and Lake Okeechobee Tributary Dredging Projects. All four of these project components share the following purposes:
 - Storage of floodwater runoff to reduce the frequency and duration of high water conditions in Lake Okeechobee that damage the lake's natural resources and require damaging discharges to the St Lucie and Caloosahatchee Estuaries.
 - Reduction of phosphorus loads to Lake Okeechobee to protect and enhance the lake's natural resources.

The total estimated project cost for the LOWP is \$456 million. Implementation of the project will be through a 50/50 partnership between the SFWMD and the Corps of Engineers. The conceptual plans consist of

construction of stormwater treatment areas (STAs) and reservoirs; restoration of wetlands; and dredging sediment from tributaries.

The planning process will be documented in a Project Implementation Report (PIR) that will be integrated with an Environmental Impact Statement (EIS).

The PIR/EIS is scheduled to be released for public review in late 2005. The Taylor Creek/Nubbin Slough Reservoir and Treatment Area Project is one of ten initially authorized projects. As a result, this project can be implemented upon approval of the PIR by the authorizing committees of Congress. The remaining LOW Project components must be authorized by an act of Congress.

The Corps of Engineers' planning process requires that projects be designed and evaluated based on future conditions. The future without project condition is used as a baseline for evaluation of project performance. For the LOWP, implementation of the LOPP will establish the foundation of the future without project condition for water quality treatment purposes.

- Exotic plant control – The Exotic Species Control Program is required to 1). Identify the exotic species that threaten native flora and fauna within the Lake Okeechobee watershed, and 2). Develop and implement measures to protect native species. The exotic plants and animals identified as threatening native species will require management of existing invasion, or in the case of some animal species, monitoring of possible future invasions.

The species lists were compiled based on discussions of interagency staff and current management efforts within the Lake Okeechobee watershed. In the future, other plants and animals may be added as new threats are discovered, or as some other minor exotic species become more dominant. In addition, while there are other exotic species within the watershed that threaten agriculture and warrant additional focus, however, the costs associated with the Protection Plan only attempt to address exotic species that threaten *native flora and fauna*.

The approach to implementation of the exotic species plan within the Lake Okeechobee watershed has been and will continue to be through the cooperative efforts of state and federal agencies. Current management efforts of these state and federal agencies include the primary exotic species that are included in this plan as well as other less invasive, exotic species not listed. Also, the program goal of each primary exotic plant species is "maintenance" level control. Florida law (F.S. 372.925) defines "maintenance control" as "a method of managing exotic plants in which

control techniques are utilized in a coordinated manner on a continuous basis in order to maintain a plant population at the lowest feasible level.” Maintenance control results in the use of less herbicides, less organic deposition in aquatic environments, less overall environmental impacts from the weeds and their management, and reduced management costs (SFWMD, 2002). Core costs associated with the implementation of the plan components (assessment, research, and treatment) have been estimated at \$XXX annually (\$XXX for torpedograss control, \$XXXX for cattail removal, and \$XXXX for Brazilian pepper removal).

- Research and monitoring program – Regardless of the alternative that is selected, the LOPP requires a comprehensive program to monitor its success in meeting the goals of reducing nutrient loads, reducing in-lake nutrient concentrations, and improving the Lake’s ecological health. This program has been developed by the SFWMD, with technical input from other agencies including the FFWCC, USFWS, USEPA, USACE, USGS, and FDEP. Much of this input occurred during development of the monitoring plan for the lake under CERP, as the programs have considerable overlap in regard to their monitoring needs. Not only does this program provide the data needed to judge success of the LOPP, but it also provides critical information for an adaptive approach to implementing the Plan, should changes in water quality or Lake ecosystem health not occur as expected as projects are constructed. The approximate cost of the core monitoring program is \$XXXXXX per year (\$XXXXXX for watershed water quality and flow monitoring, \$XXXX for in-lake water quality monitoring, and \$XXXX for in-lake biological monitoring). Additional funds, in the amount of \$XXXX per year, also are required to maintain necessary cause-effect research and model development to improve certainty about optimal implementation and operation of watershed and in-lake restoration projects and lake ecosystem responses. Thus, the total cost of the Lake Okeechobee Research and Water Quality Monitoring Program is estimated to be \$XXXXXX per year.

The remaining load following the implementation of activities under the Lake Okeechobee Watershed Current Activities section of Table 3.1 represents the phosphorus reductions required to meet the TMDL after the landowners have implemented all measures that are within their financial capability, all interagency projects are implemented with funds that have been previously appropriated for LOPA, federal agricultural program funding is utilized, and full implementation of current regional projects under the ECP and CERP, with the exception of LOWP. Two alternative plans were developed that would reduce the remaining phosphorus loads to meet the Lake Okeechobee TMDL. The alternatives were formulated with a view toward satisfying the evaluation criteria to the extent possible. **Figure 3.2** is a representation of the problem identification process and the two alternative plans that were identified.

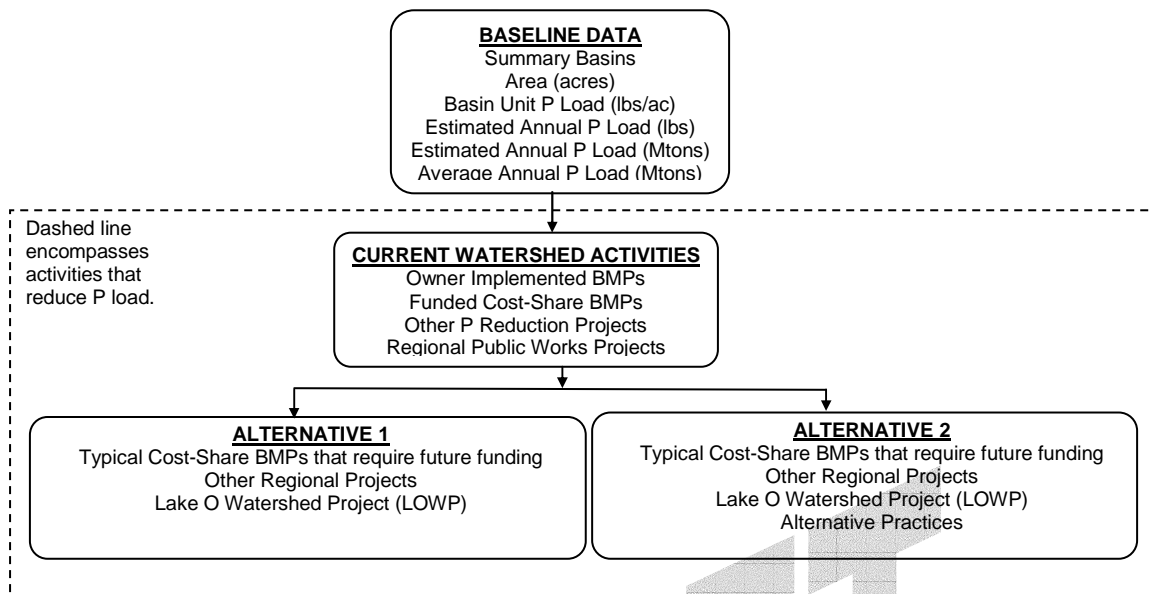


Figure 3.2. Process for Developing Alternative Plans

3.3.4 Alternatives

Alternatives were designed to achieve the TMDL in two steps. First, reductions associated with activities that fall outside the LOWP were applied and a remaining phosphorus load calculated. The remaining load from these activities, which are referred to in Table 3.1 as Options for Achieving Remaining P Reductions, represents the load that would be addressed by the LOWP. The total phosphorus load addressed by Alternatives 1 and 2 are XX metric tons and XX metric tons, respectively. These are the loads remaining after the implementation of current watershed activities (Section 3.3.1.2). The phosphorus reduction activities associated with Alternatives 1 and 2 are listed below. Note that Alternative 2 consists of all components that are included in Alternative 1 with the addition of alternative practices. Individual activities are described in the previous section.

Alternative 1

- LOPP P Reduction Tools
 - Typical Cost-Share BMPs that require future funding
 - Other regional projects
- The Lake O Watershed Project (LOWP)
- Exotic plant control
- Research and monitoring program

Alternative 2

- LOPP P Reduction Tools
 - Typical Cost-Share BMPs that require future funding
 - Other regional projects
 - **Alternative practices**
- The Lake O Watershed Project (LOWP)
- Exotic plant control
- Research and monitoring program

DRAFT

6.0 Literature Cited

BBL 2003. Blasland, Bouck & Lee, Inc. April 2003. Evaluation of Alternatives for the Lake Okeechobee Sediment Management Feasibility Study. Final deliverable associated with Contract C-11650 with the SFWMD.

Bottcher & Harper 2003, Letter Report Entitled: Estimation of Best Management Practices and Technologies: Phosphorus Reduction Performance and Implementation Costs in the Northern Lake Okeechobee Watershed.

EA 2002. EA Engineering, Science, and Technology, Inc. Lake Okeechobee Pilot Dredging Report. Final deliverable associated with Contract C-11651 with the SFWMD.

Indian River Lagoon Feasibility Study 2002 - Indian River Lagoon - South Final Feasibility Report and Supplemental Environmental Impact Statement August 2002

Mock Roos Team, 2002. Phosphorus Budget Update for the Northern Lake Okeechobee Watershed. Final report to South Florida Water Management District, West Palm Beach, FL.

Mock Roos Team, 2003. Lake Istokpoga/Upper Chain of Lakes Basin Phosphorus Source Control. Task 4 report to South Florida Water Management District, West Palm Beach, FL.

C&SF Comprehensive Review Study 1999 - C&SF Comprehensive Review Study Final Integrated Feasibility Report and Programmatic Impact Statement (PEIS) - April 1999.

SFWMD (South Florida Water Management District), 2002. Surface Water Improvement and Management (SWIM) Plan Update for Lake Okeechobee. South Florida Water Management District, West Palm Beach, FL.

Steinman, A.D., K.E. Havens, N.G. Aumen, R.T. James, K-R. Jin, J. Zhang, and B. Rosen. 1999. Phosphorus in Lake Okeechobee: Sources, Sinks, and Strategies. In: *Phosphorus Biogeochemistry of Subtropical Ecosystems: Florida as a Case Example*. Reddy, K. R., O'Conner, G. A., and Schelske, C. L. (eds). CRC/Lewis Publisher, New York.

SWET (Soil Water Engineering & Technology, Inc.), 2002. WAMView Training Manual. Developed for EPA Region IV Training. Soil Water Engineering & Technology, Inc., Gainesville, FL.

URS 2002. Value Engineering Study, Herbert Hoover Dike Rehabilitation and Repair, Reach 1. Prepared by URS Group, Inc. for the Jacksonville District of the U.S. Army Corps of Engineers.

Zhang, J., E. Colborn, R. Shah, and B. Gunsalus, 2003a. Phosphorus Budget Analysis for the Eastern Drainage Basins in the Lake Okeechobee Watershed. Final Report to South Florida Water Management District, West Palm Beach, FL.

Zhang, J., W. Donovan, D. Moss, E. Colborn, D. Pescatore, and R. Shah, 2003b. Phosphorus Budget Analysis for the Southern Drainage Basins in the Lake Okeechobee Watershed. Draft Report to South Florida Water Management District, West Palm Beach, FL.

DRAFT